TREASURY DEPARTMENT
UNITED STATES PUBLIC HEALTH SERVICE
HUGH S. CUMMING, SURGEON GENERAL

DIFFICULTIES IN COMPUTING CIVIL DEATH RATES FOR 1918

WITH ESPECIAL REFERENCE TO EPIDEMIC INFLUENZA

BY

EDGAR SYDENSTRICKER
Statistician
AND
MARY L. KING
Statistical Clerk
United States Public Health Service

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DIFFICULTIES IN COMPUTING CIVIL DEATH RATES FOR 1918, WITH ESPECIAL REFERENCE TO EPIDEMIC INFLUENZA.[1]

By EDGAR SYDENSTRICKER, Statistician, and MARY L. KING, Statistical Clerk, United States Public Health Service.

Abnormal Conditions Affecting the Distribution of Population in 1918.

Various conditions are known to have existed in 1918 which caused an abnormal distribution of population in the various demographic groups commonly employed in vital statistics. Mention has been made already of them, such as (1) the withdrawal of over 4,000,000 males of certain ages from civil life for the armed forces in the War with Germany, a condition which affected some localities more than others and which varied in its influence upon the sex and age composition of the population at different times during the period beginning April, 1917; (2) the movement of population, particularly of persons of industrial ages, to localities and areas where war industries were concentrated; (3) changes in the occupational status of the population, which were particularly important from the points of view of sex and age, since the number of women and the number of men above the usual wage-earning age were increased in some occupations; (4) a well-defined movement of negroes of certain ages from southern into northern and eastern States.

It is obvious that, in expressing mortality rates and other ratios for the period in question, some account should be taken of these factors. Their effects are too important to be ignored or to be dismissed with the comforting guess that the more or less conflicting changes had "compensating" effects. Unfortunately, their maxi-

[1] From the Statistical Office, United States Public Health Service. Acknowledgments are made to Dr. William H. Davis, chief statistician for vital statistics, Bureau of the Census, for the use of mortality data for Indiana and for computations of rates by certain methods to which specific reference is made in this paper. Reprint from the Public Health Reports, vol. 35, No. 7, Feb. 13, 1920, pp. 330-345.

mum effect came in the latter part of 1918, when, because of the pandemic of influenza, especial interest was attached to the work of the vital statistician and the epidemiologist.

A review of the literature so far published on 1918 vital statistics and on the statistics of the influenza epidemic will show that little account has been taken of the abnormal factors affecting the distribution of population, particularly from the points of view of sex and age. In a number of instances their possible effects upon mortality rates have been noted, but rarely has there been any attempt to express these effects statistically. Two very good reasons of a practical nature can be given for this omission. One is the lack of reliable data upon which to base corrections of the usual intercensal estimates. Local estimates of additions to or subtractions from the number of persons of different sex, age, occupation, etc., in the population of a given community or section are so crude as to be almost worthless in the great majority of instances.[1] The other reason is that a decennial census will be taken as of January 1, 1920, and the natural disposition is to await the results of this enumeration before attempting to correct the preliminary computations based on estimated populations. Undoubtedly the 1920 census will afford a more accurate basis for 1918 rates than estimates based on the 1910 census, but it is important to note that the 1920 enumeration comes too late to give a true picture of the abnormal situation in 1918. Already many readjustments have taken place since 1918. Practically all of the males called to the colors in the War with Germany have returned to civil life. With the cessation of munitions making and with the reduction in the manufacture of products which were in unusual demand during the war, a movement of population away from many centers of "war industries" has set in. Even in those localities where the stimulus of war industries has continued there have doubtless occurred marked changes in the sex, age, and occupation distribution of persons employed because of displacements that have followed the replacements occasioned by the war. So that even with the results of the 1920 census before him, the vital statistician will be put to it to obtain reasonably accurate population bases for computing his ratios for 1918. Certain modifications of population figures as enumerated for 1920 will be necessary in estimating populations for 1918, and he will need all of the data that he can collect relating to purely local population changes and to males withdrawn from civil life.

In view of the fact that it will be some time before the results of the 1920 census are known in any considerable detail, and in view of the practical necessity for as correct population bases as it is possible to get for use in computing preliminary rates, some consideration has

[1] At the same time more use can be made than has been made of statistics of employment, for example, for determining changes in population in communities.

been given in this office to the question of making tentative corrections of population estimates, especially for sex and age, in computing influenza and pneumonia mortality rates for 1918. In the following pages an attempt is made to utilize such data as are available relating to the withdrawal of males of certain ages from the civil population in 1918. In order to test the probable accuracy of rates computed upon the basis of population estimates corrected, or modified, from this point of view, a method of estimating population by the use of "normal" death rates from certain causes has been applied, and the results have been compared with the mortality curve for males according to age as computed from data collected among specially canvassed "sample" populations.

Correction of Population Estimates by Taking into Account the Withdrawal of Males from Civil Life in 1918.

The most complete information so far published relating to the number of males withdrawn from civil life during 1917 and 1918 is furnished in the Second Report of the Provost Marshal General.[1] From these data several tables have been compiled in the belief that they may be of value to officers of health departments and others interested in vital statistics, and are presented herewith.

TABLE I.—*Number of males withdrawn from civil life in the United States from April 1, 1917, to January 1, 1919, by months, and the percentages they were of total population, of males of all ages, and of males of ages 18–45, inclusive.*

Months (1917–18).	Males withdrawn from civil life—Ages 18–45.				
	Number.		Cumulative per cent of—		
	By months.	Cumulative.	Total population.	Males.	
				All ages.	Ages 18–45.
Total	4,178,172	4,178,172	100.00	100.00	100.00
1917—April	113,633	113,633	.11	.21	.48
May	146,868	260,501	.25	.49	1.10
June	150,249	410,750	.40	.77	1.73
July	85,838	496,588	.48	.93	2.09
August	66,172	562,760	.54	1.05	2.36
September	324,248	887,008	.85	1.66	3.72
October	210,392	1,097,400	1.05	2.05	4.60
November	90,395	1,187,795	1.14	2.22	4.97
December	194,700	1,382,495	1.32	2.58	5.78
1918—January	93,522	1,476,017	1.41	2.75	6.16
February	121,693	1,597,710	1.53	2.97	6.66
March	169,791	1,767,501	1.69	3.28	7.36
April	220,079	1,987,580	1.89	3.68	8.26
May	428,466	2,416,046	2.30	4.47	10.03
June	431,582	2,847,628	2.71	5.26	11.80
July	452,417	3,300,045	3.13	6.10	13.66
August	346,924	3,646,969	3.46	6.72	15.08
September	273,080	3,920,049	3.71	7.22	16.18
October	249,185	4,169,234	3.94	7.67	17.19
November	8,938	4,178,172	3.94	7.67	17.21

[1] Crowder, E. H., Second Report of the Provost Marshal General on the Operations of the Selective Service System to Dec. 20, 1918, Government Printing Office, Washington, D. C., 1919. This report covers the period from May 18, 1917, the date of the selective service act, to Dec. 20, 1918, and contains also information relating to voluntary enlistments in the Army, Navy, and Marine Corps for the same period.

TABLE I–A.—*Estimated number of persons of specified sex and ages in total population of the United States.*

Age and sex.	July 1, 1917.	July 1, 1918.
All ages: Both sexes	103,635,306	105,253,300
All ages: Males	53,268,547	54,100,196
Males: Ages 18–45	23,757,772	24,128,687

In Table I are shown the monthly increments and total increase of the armed forces of the United States (inductions through the selective service, and enlistments in the Army, Navy, and Marines) during the period April, 1917, to November, 1918, exclusive of the inductions in October and November, 1918, which were on account of the third registration. The last inductions mentioned were nearly all of students in schools and colleges, made just before the armistice was signed, and, for practical purposes, the men so inducted need not be considered as withdrawn from civil life. Taking the male population of the age group 18 to 45, inclusive, in the United States, estimated as of July 1, 1917, and July 1, 1918, as the bases, the cumulative per cent withdrawn from civil life at the end of each month from April 1, 1917, to November 30, 1918, has been computed. In Figure I the monthly increments as well as the cumulative totals and the percentages referred to have been plotted. It will be noted that at the time of the influenza epidemic in October and November, 1918, the civil population had been decreased by something over 4,000,000 persons. This was equivalent to nearly 4 per cent of the entire population, nearly 8 per cent of the entire male population, and about 17 per cent of males in the ages 18 to 45, as estimated for July 1, 1918. While the figures are not absolutely accurate, particularly in that no account can be taken of the discharge of soldiers from camps or of commissioned officers,[1] they are sufficiently correct to show that the number of males of these ages in civil life was so considerably decreased that any computation of specific mortality rates, for example, according to age, based on the estimated population without allowing for withdrawals on account of military duty, would be seriously erroneous.

Since neither the total population nor the number of males of all ages nor the number of males of specific ages in continental United States is ordinarily used in computing mortality rates, Table I does not afford any data for practical use except the cumulative percentages by months. Similar data for States or smaller divisions are not afforded,

[1] It appears that 8.1 per cent of men actually inducted into service during the period Feb. 10–Nov. 1, 1918, were later rejected on physical examinations after reaching camp (Second Report of the Provost Marshal General, p. 420, Table 56–A). How large a percentage of enlisted men was rejected for this reason is not stated, so far as the writers are able to ascertain. The figures given in Table I are therefore somewhat high. On the other hand, about 230,000 commissioned officers are not included in Table I.

but the monthly cumulative percentages for the country as a whole can be applied to the State totals (as given in Table II) or to totals for localities that can be determined from State enlistment figures and from the returns from local exemption boards which are published in the report referred to. Upon the assumption that the population

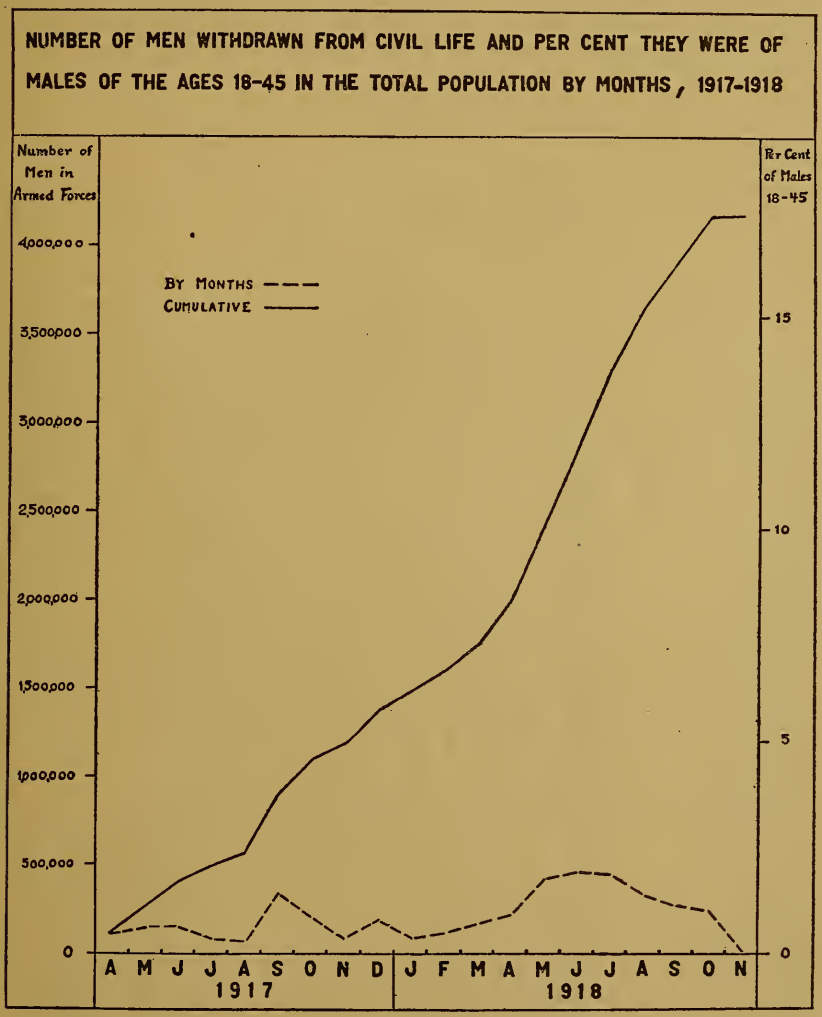

FIGURE 1.

in each locality or larger division was affected in about the same way as the population of the country at large, a rough approximation can be made of the number of withdrawals of males from civil life at the end of any month in the locality or section in question. This approximation, of course, can be used in connection with the percentage distribution of males actually withdrawn (see Tables III and IV)

and some crude estimate can be made of the population in different age groups remaining in civil life at the end of any month in the period from April 1, 1917, to November 30, 1918.

In Table II are given the total increments to November, 1918, from various sources in each State. The figures for white and colored combined are available for men inducted but not for men enlisted. Since only 1.5 per cent of enlisted men were colored, however, the number of colored males for practical purposes is negligible.

TABLE II.—*Enlistments and inductions, Apr. 2, 1917, to Oct. 31, 1918, under first and second registrations, compared by States.*[1]

Locality.	Total increment.	Total inducted.	Total enlisted.	White.					Colored inducted.
				Total.	Inducted.	Enlisted.			
						Army.	Navy.	Marines.	
United States	4,034,743	2,666,867	1,367,876	3,667,033	2,299,157	877,458	437,527	52,891	367,710
Alabama	73,543	59,755	13,788	47,669	33,881	9,562	3,938	288	25,874
Arizona	11,410	8,113	3,297	11,333	8,036	1,854	1,269	174	77
Arkansas	65,311	49,312	15,999	47,767	31,768	11,699	4,025	275	17,544
California	131,484	67,067	64,417	130,565	66,148	38,992	23,058	2,367	919
Colorado	38,751	22,858	15,893	38,389	22,487	9,670	5,075	1,148	371
Connecticut	55,218	32,539	22,679	54,277	31,598	13,151	9,319	209	941
Delaware	7,985	4,993	2,992	6,620	3,628	2,003	919	70	1,365
District of Columbia	17,945	9,631	8,314	13,945	5,631	4,442	3,500	372	4,000
Florida	36,211	24,916	11,295	23,307	12,012	6,834	4,375	86	12,904
Georgia	86,973	66,841	20,132	52,670	32,538	14,160	5,382	590	34,303
Idaho	20,467	12,566	7,901	20,372	12,471	4,955	2,450	496	95
Illinois	272,235	177,483	94,752	263,481	168,729	61,938	28,264	4,550	8,754
Indiana	104,973	69,749	35,224	100,394	65,170	25,847	8,313	1,064	4,579
Iowa	101,638	66,864	34,774	100,709	65,935	26,389	7,832	553	929
Kansas	66,645	41,905	24,740	64,518	39,778	18,217	5,907	616	2,127
Kentucky	77,983	58,330	19,653	66,663	47,010	13,934	5,163	556	11,320
Louisiana	71,271	56,205	15,066	42,560	27,494	7,570	6,782	714	28,711
Maine	26,602	15,266	11,336	26,552	15,216	7,290	4,025	21	50
Maryland	51,700	33,867	17,833	42,488	24,655	10,144	6,913	776	9,212
Massachusetts	157,101	76,567	80,534	155,901	75,367	41,985	36,884	1,665	1,200
Michigan	142,397	96,480	45,917	140,002	94,085	32,403	11,463	2,051	2,395
Minnesota	106,918	73,680	33,238	106,407	73,169	20,272	10,588	2,378	511
Mississippi	56,740	43,362	13,378	32,674	19,296	9,044	4,069	265	24,066
Missouri	140,257	92,843	47,414	131,038	83,624	29,863	14,132	3,419	9,219
Montana	39,049	27,340	11,709	38,851	27,142	7,331	3,281	1,097	198
Nebraska	49,614	29,807	19,807	48,972	29,165	14,416	4,944	447	642
Nevada	5,488	3,164	2,324	5,462	3,138	1,888	350	86	26
New Hampshire	14,970	8,404	6,566	14,943	8,377	4,408	2,100	58	27
New Jersey	118,350	71,390	46,960	113,487	66,527	28,333	17,457	1,170	4,863
New Mexico	13,586	8,862	4,724	13,535	8,811	3,649	1,050	25	51
New York	410,569	253,589	156,980	404,376	247,396	89,031	61,779	6,170	6,193
North Carolina	74,705	58,441	16,264	54,623	38,359	10,573	5,250	441	20,082
North Dakota	27,253	18,595	8,658	27,166	18,508	6,611	1,838	209	87
Ohio	205,852	138,148	67,704	197,991	130,287	48,885	14,176	4,643	7,861
Oklahoma	84,909	64,941	19,968	79,215	59,247	14,105	5,513	350	5,694
Oregon	34,430	16,158	18,272	34,362	16,090	10,626	6,694	952	68
Pennsylvania	313,297	201,211	112,086	297,905	185,819	78,671	29,446	3,969	15,392
Rhode Island	22,270	11,176	11,094	21,979	10,885	5,436	5,600	58	291
South Carolina	54,284	44,059	10,225	28,486	18,261	6,505	3,675	45	25,798
South Dakota	30,130	21,255	8,875	30,068	21,193	7,083	1,663	129	62
Tennessee	80,139	59,878	20,261	62,365	42,104	13,563	5,425	1,273	17,774
Texas	174,061	117,395	56,666	142,555	85,889	37,704	16,889	2,073	31,506
Utah	19,421	10,788	8,633	19,344	10,711	5,335	2,494	804	77
Vermont	11,223	6,629	4,594	11,201	6,607	3,088	1,488	18	22
Virginia	78,524	58,337	20,187	54,983	34,796	10,556	9,144	487	23,541
Washington	55,433	28,686	26,747	55,260	28,513	12,761	12,382	1,604	173
West Virginia	55,895	45,355	10,540	50,403	39,863	7,359	2,625	556	5,492
Wisconsin	101,696	70,982	30,714	101,472	70,758	22,349	7,569	796	224
Wyoming	12,223	7,923	4,300	12,128	7,828	3,554	656	90	95
Alaska	2,105	1,962	143	2,100	1,957	143	.....	.....	5
Hawaii	5,733	5,466	267	5,733	5,466	267	.....	.....	.....
Porto Rico	16,490	15,734	756	16,490	15,734	756	.....	.....	.....
Not located	1,286	.....	1,286	1,286	.....	254	394	638	.....

[1] Compiled from the second report of the Provost Marshal General, pp. 468 and 459.

The report of the Provost Marshal General already referred to shows for each local exemption board the number of men accepted at camp, but it does not give the number of enlisted men from each locality. Here again rough approximation must be resorted to. The number of men withdrawn from a given locality by enlistments can be estimated by using the ratio of inductions to enlistments for the particular State and applying it to the inductions from the locality. This, however, will afford rather doubtful results except possibly for the large population centers.

Since the males withdrawn from the civil population were almost entirely within the ages 18 to 45, and principally within the ages 21 to 31, corrections of population estimates for males of specific ages or age groups are especially important. Unfortunately, no tabulation by years of age of the number of men inducted into or enlisted in the armed forces has as yet been published.[1] About the closest approximations that can be made are from the percentage distribution of registered men actually placed in Class I for the country as a whole,[2] and from Army and Navy estimates (based on sampling) of the number of enlisted men who were of the ages under 21 and over 30.[3] Since no statistics are available as to the distribution of enlisted men in the age group 21 to 30, we must assume that the distribution was the same as for the selective service men who were actually placed in Class I. Without presenting the detailed computations, the approximations arrived at are presented in Table III, which shows the number of men of each age and the percentage they were of totals inducted and enlisted in the various services in the United States as a whole. For reasons that are apparent, the figures thus obtained are approximations only, but it is believed that they afford reasonably accurate percentages of distribution which can be utilized in making estimates for States or smaller geographic divisions. Since 5-year age groups ordinarily are utilized in computing rates, the percentage distribution given in Table III is summarized by 5-year age groups in Table IV.

[1] The Provost Marshal General's second report gives in detail the number of men by years of age who were *registered* for selective service in each State, but not the number of men by years of age who were actually inducted or who had enlisted. A tabulation is presented showing, for men inducted in 1917, the proportions of registered males for each year of age from 21 to 30, inclusive, who were placed in Class I for the country as a whole (Id. p. 189, Table 67). The percentages varied from 46.3 for those 21 years of age to 22.1 for those 30 years of age. If it can be assumed that these ratios held for any State (and probably they are sufficiently accurate for the purpose), the number of men placed in Class I can be estimated for each year of age. It is not believed, however, that this method would yield more accurate estimates than the one which is immediately suggested.

[2] Id. p. 189, Table 67.

[3] Id. p. 317.

TABLE III.—*Number of males withdrawn from civil life for service in the armed forces, and estimated number in each age, during 1917 and 1918, in the United States.*

Age.	Total.		Enlistments.								Inductions.	
			Army.		Navy.		Marines.		Total enlistments.			
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
All ages.	4,034,743	100.0	877,458	100.0	437,527	100.0	52,891	100.0	1,367,876	100.0	2,666,867	100.0
18	62,210	1.5	35,537	4.0	24,611	5.6	2,062	3.9	62,210	4.6	.....	.....
19–20	352,526	8.8	201,377	23.0	139,461	31.9	11,688	22.1	352,526	25.8	(1)	.....
21	819,577	20.3	73,522	8.4	32,158	7.4	4,510	8.5	110,190	8.1	709,387	26.6
22	403,718	10.0	66,520	7.6	29,096	6.6	4,080	7.7	99,696	7.3	304,022	11.4
23	374,888	9.3	61,519	7.0	26,908	6.2	3,773	7.2	92,200	6.7	282,688	10.6
24	335,807	8.3	55,017	6.3	24,064	5.5	3,374	6.4	82,455	6.0	253,352	9.5
25	294,061	7.3	48,515	5.5	21,220	4.8	2,976	5.6	72,711	5.3	221,350	8.3
26	268,646	6.7	44,013	5.0	19,251	4.4	2,700	5.1	65,964	4.8	202,682	7.6
27	247,398	6.1	40,512	4.6	17,720	4.0	2,485	4.7	60,717	4.4	186,681	7.0
28	243,981	6.1	40,012	4.6	17,501	4.0	2,454	4.6	59,967	4.4	184,014	6.9
29	209,067	5.2	34,510	3.9	15,095	3.4	2,117	4.0	51,722	3.8	157,345	5.9
30	219,317	5.4	36,011	4.1	15,751	3.7	2,209	4.2	53,971	3.9	165,346	6.2
Over 30	203,547	5.0	140,393	16.0	54,691	12.5	8,463	16.0	1,203,547	14.9	.....	.....

[1] 143,429 were inducted from the third registration, presumably college students enrolled in student Army camps. They are not included here.

TABLE IV.—*Approximated percentages of males enlisted in the Army, Navy, and Marines, and inducted during 1917–18, who were in specified age groups.*

Age groups.	Enlisted.				Inducted.
	Army.	Navy.	Marines.	Total.	
All ages	100.0	100.0	100.0	100.0	100.0
15–19	15.5	21.6	15.0	17.5	.....
20–24	40.8	41.6	40.8	41.0	58.1
25–29	27.7	24.3	28.2	26.6	35.7
30 and over	16.0	12.5	16.0	14.9	6.2

With these data before us, the following method of utilizing them in correcting population estimates for the latter part of 1918, from the single point of view of withdrawals of males from civil life, seems to be logical and practicable:

For a given State, find the number of males inducted (Table II) and multiply this number by the percentages for different ages for inducted men (Table III or Table IV). The resulting figures are the estimated number of males of different ages or age groups withdrawn from civil life by the selective service law. Proceed in the same manner for men enlisted in each of the different services (Army, Navy, and Marines). Summate for each age or age group the number of men withdrawn by inductions and enlistments, and subtract from the estimated male population as of July 1, 1918, in corresponding ages or age groups. The remainder will be an estimate of the male population of the ages specified who were in civil life at the time under consideration.

Population Estimates on the Basis of Normal Death Rate from Selected Causes.

For localities or sections where no other causes are known to have affected distribution of population according to age, occupation, etc., in an appreciable degree, a correction of the effect of withdrawals of males for military service will be sufficient. The vital statistician must, of course, determine from such information as he can obtain whether or not any other important causes were at work.

It is safe to say, however, that in a number of States and localities abnormal conditions other than the withdrawal of males for military service did affect the population. In any event, it is highly desirable to have some criterion by which the combined influences of the various possible conditions may be expressed statistically. Sampling by means of actual enumerations was not resorted to, except in a few instances for special purposes. Is there any other method simple enough for every day use? We are indebted to the division of vital statistics of the Bureau of the Census for a method which has been used in checking estimates arrived at by conventional procedure.

A death rate is made up of two factors: The number of persons in the group considered and the number of deaths occurring among those persons from the cause or causes in question. The usual formula is

$$\frac{\text{Number of deaths} \times 1{,}000}{\text{Population}} = \text{Rate}$$

If the death rate during a normal period from certain causes be used as the divisor and the number of deaths (multiplied by 1,000) from the same causes during the period for which a population estimate is desired be the dividend, the quotient will be the desired estimate of the population. To illustrate:

Let the number of deaths from all causes, other than acute infections diseases, among males of the age group 20 to 24 during the period September–December, 1918, = 300. Let the death rate from the same causes among males of the same ages during a period which is assumed to be normal; e. g., the average for September–December for the years 1909–1911 = 2 per 1,000. Then

$$\frac{300 \times 1{,}000}{2} = 150{,}000$$

which is an estimate of the number of males in September–December, 1918. Of course this estimate involves several assumptions, important among which is that the death rate of 2 per 1,000 from the causes specified did not change from 1909-1911 to 1918. But grant-

ing that this estimate is fairly accurate, the specific rate for any disease for 1918 may be computed.[1]

A Comparison of Rates Derived from Different Population Estimates made by the Various Methods Described.

It will be of interest now to compare the results derived by the use of the various methods described.

The deaths from influenza and pneumonia (all forms) during the four months' period, September 1 to December 31, 1918, among males of different ages in Indiana are used (Table V). Three sets of annual rates are computed; namely, (1) a rate based on the number of males in each age group as estimated for July 1, 1918, by the usual arithmetic method for intercensal years; (2) a rate based on the number of males in each age group as estimated in (1), but after subtracting, for certain age groups, the number of males withdrawn from civil life up to November 30, 1918; (3) a rate based on the normal death rate from all causes except pneumonia (all forms), computed according to either of the two methods used by the vital statistics division of the Bureau of the Census. For convenience we may denote them as rate 1, rate 2, and rate 3.

TABLE V.—*Number of deaths from influenza and pneumonia (all forms) and from all other causes among males in Indiana Sept. 1,–Dec. 31, 1918.*

Age groups.	Influenza and pneumonia (all forms).	All other causes.
Under 5	833	1,042
5 to 9	187	107
10 to 14	166	103
15 to 19	360	161
20 to 24	371	143
25 to 29	611	188
30 to 34	619	199
35 to 39	452	227
40 to 44	214	224
45 to 49	117	262
50 to 54	87	261
55 to 59	61	286
60 to 64	66	423
65 and over	209	1,880

[1] This method involves a good deal of arithmetical labor, and practically the same result is obtained by a shorter procedure employed by the vital statistics division of the Bureau of the Census. This procedure involves exactly the same principle as the one described above, but the actual computation of a new estimate of population is eliminated. For example, in checking the accuracy of the calculated death rates from influenza and pneumonia in Indiana during September–December, 1918, rough death rates were found as follows: Graduated data of 1909, 1910, and 1911 were first used to find a set of normal death rates by age and sex as in the construction of a life table. To make these rates more nearly accord with rates based on all deaths except influenza and pneumonia (all forms) to total deaths, the percentages of deaths from pneumonia (all forms) to total deaths by ages and sex in 1910 were calculated and the life-table rates reduced to corresponding amounts. (No allowance was made for influenza deaths in 1910 as this was considered an unnecessary refinement for this rough calculation.) The resulting death rates were assumed to represent the death rates from all causes except influenza and pneumonia (all forms) as primary causes in the last four months of 1918, and rough death rates were then calculated in the following manner: The per cent of total deaths in the last four months of 1918 which were from influenza and pneumonia (all forms) was divided by the per cent which were from all other causes. The quotient was then multiplied by the assumed normal annual death rate from all causes except pneumonia (all forms) based on graduated data of 1909, 1910, and 1911. The product is a rough annual death rate from influenza and pneumonia (all forms) for the last four months of 1918 among persons of a specific sex and age.

In computing rates 1 and 2, the detailed population estimates are presented for purposes of illustration in Table VI. The number of males in each age group as estimated by the usual arithmetic method for intercensal years is shown in the first column. In the next five columns are shown the number of males withdrawn from civil life, approximated according to the procedure previously outlined. In the last column is given the estimated number of males in each age group after allowing for these withdrawals.

TABLE VI.—*Number of males of different ages in Indiana, estimated as of July 1, 1918, by arithmetic method and after deducting therefrom males withdrawn from civil life in 1917 and 1918.*

Age groups.	Male population, estimated as of July 1, 1918.	Number of males withdrawn from civil life.					Male-population estimates, less males withdrawn from civil life.
		Total.	Inducted.	Enlisted.			
				Army.	Navy.	Marines.	
All known ages	1,459,353	104,973	69,749	25,847	8,313	1,064	1,354,380
Under 5	148,043						148,043
5 to 9	142,066						142,066
10 to 14	136,535						136,535
15 to 19	138,586	5,963		4,007	1,796	160	132,623
20 to 24	133,999	54,961	40,524	10,545	3,458	434	79,038
25 to 29	123,154	34,380	24,900	7,160	2,020	300	89,774
30 to 34	106,605	9,669	4,325	4,135	1,039	170	96,936
35 to 39	103,154						103,154
40 to 44	90,604						90,604
45 to 49	77,681						77,681
50 to 54	75,345						75,345
55 to 59	55,955						55,955
60 to 64	45,797						45,797
65 and over	81,829						81,829

In Table VII are shown the annual rates computed by the three methods. These rates are plotted in Figure 2.

TABLE VII.—*Annual death rate per 1,000 males of different ages in Indiana from influenza and pneumonia (all forms), September–December, 1918, computed upon the bases of various estimates of population.*

Age groups.	1 Based on population as estimated by arithmetic method.	2 Same as 1, but after allowing for withdrawal of males from civil life.	3 Based upon normal death rate from all causes other than pneumonia.
Under 5	16.8	16.8	20.4
5 to 9	3.9	3.9	4.7
10 to 14	3.6	3.6	3.7
15 to 19	7.8	8.1	8.2
20 to 24	8.3	14.0	13.8
25 to 29	14.8	20.4	16.8
30 to 34	17.3	20.1	18.4
35 to 39	13.1	13.1	12.8
40 to 44	7.1	7.1	7.2
45 to 49	4.5	4.5	4.3
50 to 54	3.5	3.5	3.8
55 to 59	3.3	3.3	3.8
60 to 64	4.3	4.3	4.0
65 and over	7.6	7.6	8.6

It will be observed that the rates are practically identical for all ages except those between 15 and 35, thus indicating the fact that certain conditions existed which disturbed the normal age distribution of the male population of those ages. Which of the three rates

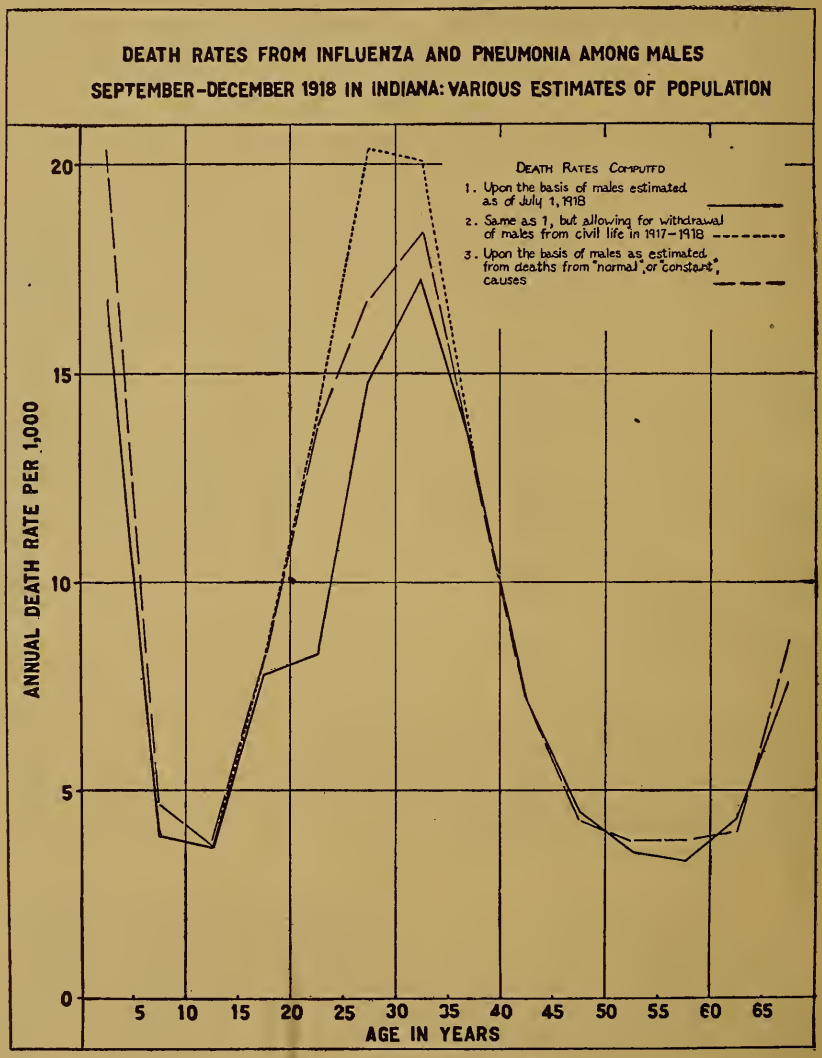

FIGURE 2.

is the correct one? Or, rather, which of the three rates most nearly approximates the correct rate? Rate 1 is much lower, particularly in the age group 20 to 24, than rates 2 and 3, suggesting the conclusion that the computation of a mortality rate upon the basis of an estimated

population without taking into account the withdrawal of males from civil life is quite inaccurate. As between rates 2 and 3, the suggestion is offered that rate 2 is too high because the withdrawal of males from civil life may have been compensated by an abnormal addition of

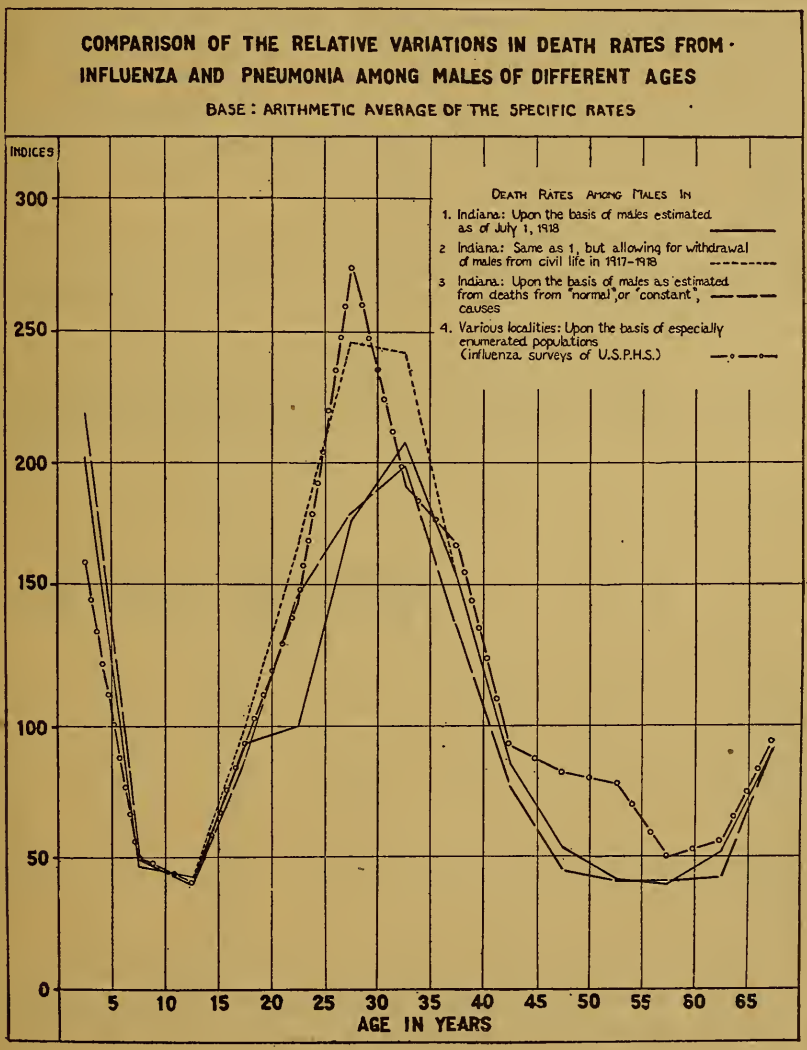

FIGURE 3.

males in certain occupations. In weighing the relative accuracy of rates 2 and 3, however, we must take into consideration other possible conditions, as, for example, the demand in Indiana for males of these ages for employment in the so-called war industries. As a matter of

fact, Indiana was a State where comparatively few war industries were located and there was a tendency toward emigration rather than toward an immigration.

In order to test this assumption the various curves already computed may be compared with the mortality curve among males of a canvassed population. Accordingly, in Figure 3 the rates have been reduced to a relative basis, and a fourth curve—that of mortality from influenza and pneumonia among males of different ages who were actually canvassed in the course of special influenza surveys made in various localities in the United States by the Public Health Service—has been fitted in. This fourth curve, which we may denote as rate 4, is considered as the normal.

If it be true that rate 4 can properly be regarded as a normal one for the period of the influenza epidemic, it is clearly indicated that (Table VIII and Fig. 3) the rate which most closely approximates it for Indiana is rate 2.[1]

TABLE VIII.—*Comparison of the relative variations in death rates from influenza and pneumonia (all forms), computed by various methods for males of different ages in Indiana, September–December, 1918, with that in areas where special surveys were made.*

[Base: Arithmetic average of the specific rates.]

Age groups.	1 Population estimated by usual method.	2 Same as 1, but after allowing for males withdrawn from civil life.	3 By census method.	4 Localities canvassed.
Under 5	202	202	219	149
5 to 9	47	47	51	37
10 to 14	43	43	40	27
15 to 19	94	98	88	78
20 to 24	100	169	148	133
25 to 29	178	246	181	261
30 to 34	208	242	198	178
35 to 39	158	158	138	155
40 to 44	86	86	77	80
45 to 49	54	54	46	69
50 to 54	42	42	41	65
55 to 59	40	40	41	37
60 to 64	52	52	43	43
65 and over	92	92	92	82

A similar result has been found in comparing rates computed upon the various bases for other sections and localities.

In this connection it may be noted that if the ratio be computed for each age group of the number of males and of females enumerated in the special influenza survey made in Baltimore, Md., during December, 1918, to that enumerated in the 1910 census of the same

[1] The divergences of the rates in the ages 40 and over are probably due to a paucity of data, since the number of deaths and the number of persons in those ages in the special surveys were rather small.

city, it will be seen that a very marked depletion of males of the ages 18 to 35 occurred. This has been done in Table IX and plotted in Figure 4. While the number of persons included in the survey was relatively small (about 32,000), and the sample is not large enough to afford as great regularity in results as would be desirable, the

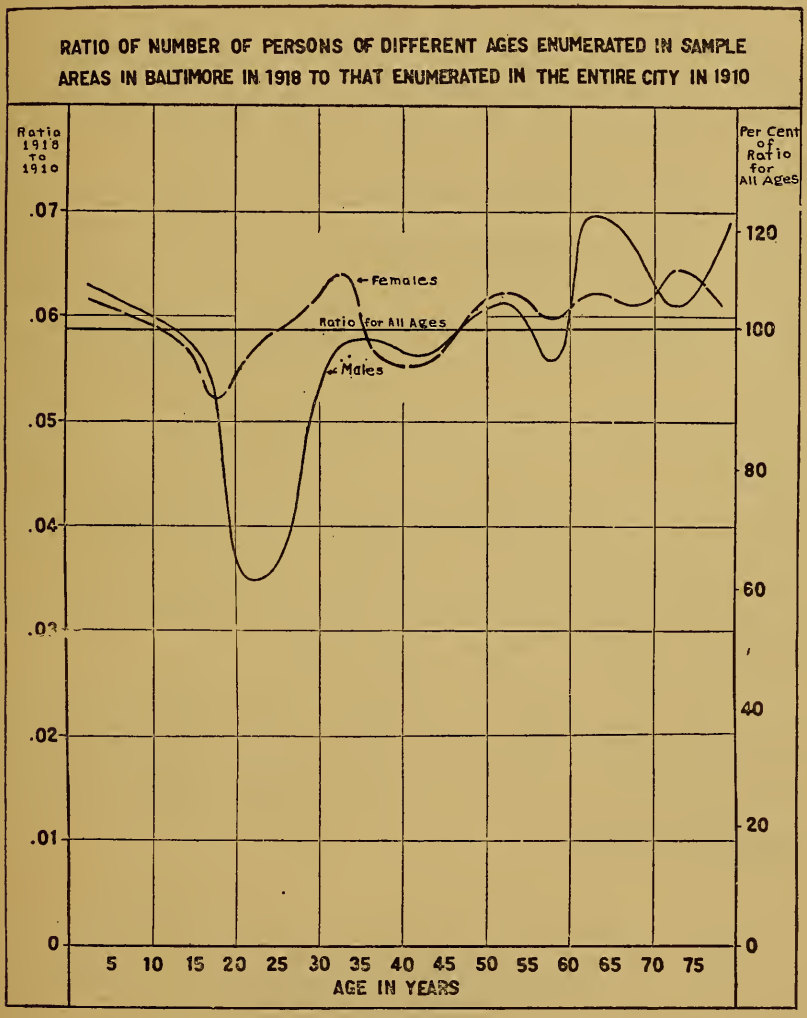

FIGURE 4.

great divergence of the distribution of males in the ages 18 to 34 from that of males and females in the same ages in 1910 in December, 1918, is unmistakably manifest. Here, therefore, in a center of industrial activity the depletion of the male population of military age far outweighed accretions.

TABLE IX.—*Ratio of number of persons of different ages enumerated in sample areas in Baltimore in 1918 to that enumerated in the entire city in 1910.*

Age period.	Population.						Ratio, 1918 to 1910.			Indices of ratios.		
	Both sexes.		Male.		Female.		Both sexes.	Male.	Female.	Both sexes.	Males.	Females.
	1910	1918	1910	1918	1910	1918						
All ages	557,790	31,697	267,897	14,677	289,893	17,020	0.0568	0.0548	0.0587	100	.....	.....
Under 5	51,986	3,226	26,189	1,641	25,797	1,585	.0621	.0627	.0614	109	111	108
5 to 9	49,617	2,988	24,739	1,500	24,878	1,488	.0602	.0606	.0598	106	107	105
10 to 14	48,507	2,826	23,564	1,375	24,943	1,451	.0583	.0584	.0582	103	103	102
15 to 19	54,253	2,815	25,124	1,304	29,129	1,511	.0519	.0519	.0519	91	91	91
20 to 24	58,713	2,749	27,373	959	31,340	1,790	.0468	.0350	.0571	82	62	101
25 to 29	54,311	2,826	26,127	1,138	28,184	1,688	.0520	.0436	.0599	92	77	105
30 to 34	45,604	2,758	22,195	1,260	23,409	1,498	.0605	.0568	.0640	107	100	113
35 to 39	43,163	2,445	21,029	1,207	22,134	1,238	.0566	.0574	.0559	100	101	98
40 to 44	36,963	2,057	17,852	1,000	19,111	1,057	.0557	.0560	.0553	98	99	97
45 to 49	31,627	1,880	15,367	912	16,260	968	.0594	.0593	.0595	105	104	105
50 to 54	26,510	1,631	12,856	784	13,654	847	.0615	.0610	.0620	108	107	109
55 to 59	18,607	1,071	8,987	499	9,620	572	.0576	.0555	.0595	101	98	105
60 to 64	14,351	936	6,541	452	7,810	484	.0652	.0691	.0620	115	122	109
65 to 69	10,454	663	4,662	311	5,792	352	.0634	.0667	.0608	112	117	107
70 to 74	6,647	417	2,800	170	3,847	247	.0627	.0607	.0642	110	107	113
75 and over	6,477	409	2,492	165	3,985	244	.0631	.0662	.0612	111	117	108

Unless in a given locality there are known to have been considerable accretions to the male population of the ages under consideration, which offset the depletion due to withdrawals for military service, rates based on the estimated number of total males or females in each age group, after allowing for withdrawals for military service, will be more accurate than rates which do not take into account these withdrawals. Probably they will be more nearly correct than rates computed on the basis of "normal" death rates.

At best, such corrections as can be made of population estimates for 1918 are very rough approximations. The foregoing may prove suggestive to health departments as rather simple methods for making corrections for the withdrawal of males of certain ages from civil life, and for testing rates based upon "corrected" and "uncorrected" population estimates.

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